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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/020,565 01/16/98 LYDING J 22010-128/IL

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KENNETH A GANDY WOODARD EINHARDT
NAUGHTON MORIARTY AND MCNETT
BANK ONE TOWER SUITE 3700
111 MONUMENT CIRCLE
INDIANAPOLIS IN 46204-5137

EXAMINER

LEE, H

ART UNIT

PAPER NUMBER

2823

DATE MAILED:
09/30/99

#8

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.
09/020,565

Applicant(s)
Lyding et al.

Examiner
Hsien-Ming Lee

Group Art Unit
2823



☒ Responsive to communication(s) filed on Aug 2, 1999

☒ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) 1-14, 28-35, and 40-49 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☒ Claim(s) 40-49 is/are allowed.

☒ Claim(s) 1-14 and 28-35 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been
☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

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DETAILED ACTION

Grounds of Rejection

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-14, 28-31, 33-35 rejected under 35 U.S.C. 102(b) as being anticipated by Lisenker et al., National Semiconductor (submitted by applicant).

See page 4, line 19 through page 5, line 29; page 6, lines 10-36; page 7, lines 25-29; page 8, line 29 through page 9, line 25; page 10, line 26 through page 11, line 22; page 12-14.

Lisenker et al. teach the claimed method for conditioning a semiconductor device to increase its resilience to hot carrier effects, comprising passivating the device with molecular deuterium comprises deuterium gas and nitrogen (page 4, line 30; page 8, line 29 through page 9, line 1; and page 9, lines 15-25) in an area of the device subject to hot carrier effects; and heating the device (page 4, line 30); wherein the semiconductor device includes a silicon layer and an insulative layer (silicon oxide) adjacent the silicon layer (page 6, lines 32-35); the deuterium ambient includes 1% to 100% by volume deuterium gas (page 14, claim 17);heating

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the device at a temperature of about 500C in a deuterium ambient (page 9, lines 15-22); and the device includes at least one metal oxide semiconductor (MOS) transistor (page 11, lines 5-8).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lisenker et al. as applied to claim 28 above, and further in view of Brown et al. (submitted by applicant).

Lisenker et al. disclose substantially the claimed method of conditioning a semiconductor device to increase its resilience to hot carrier effects, comprising disposing deuterium in an area of the device subject to hot carrier effects, and heating the device (see page 4, line 19 through page 5, line 29; page 6, lines 10-36; page 7, lines 25-29; page 8, line 29 through page 9, line 25; page 10, line 26 through page 11, line 22; page 12-14) with the exception of including a silicon nitride layer in the device.

However, Brown et al. (submitted by applicant) teach the utilization of silicon nitride layer in a semiconductor device, particularly in a metal oxide semiconductor (MOS), as a dielectric layer due to its higher dielectric constant.

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Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to include a silicon nitride layer as taught by Brown (see col. 1, lines 9-23) in the semiconductor device as taught by Lisenker to improve the reliability of the device, since this combination would result in the advantages of the imperviousness to water vapor and ion diffusion, and radiation shielding.

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

* Park et al. (submitted by applicant; title: The Effect of Annealing Treatment on the Distribution of Deuterium in Silicon and Silicon/Silicon Oxide Systems) teach the passivation of Si/SiO₂ structure for the application of MOS through deuterium-anneal process.

* Saks et al. (submitted by applicant; title: Time-dependence of the interface trap build-up in deuterium-annealed oxides after irradiation) teach that MOS device was processed incorporate with deuterium by annealing.

* Myers et al. (submitted by applicant; title: Interactions of deuterium with ion-irradiated SiO₂ on Si) teach the utilization of deuterium-anneal for MOS.

Response to Preliminary Amendment

6. The amended claims 1, 2, 6, 28-30, 32 and newly added claims 47-49 in the applicant's preliminary amendment faxed on August 2, 1999 have been fully considered but they are rejected

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under the same reasons as stated on the above. The newly added claims 40-46 have been fully considered.

With respect to amended claims 1 and 28, the previous Office Action states that Lisenker's teaching discloses a method for treating a MOS transistor (on page 3) which includes field effect transistor device having conductive contacts for a source, drain and gate; and the step of passivating the device with deuterium was performed after conductive contacts of a source, drain and gate of the device have been fabricated.

With respect to amended claim 6, Lisenker's teaching discloses that the deuterium-enriched ambient is at about one atmosphere (page 9, lines 15-25), and the specification of the instant teaches that it can be performed at atmospheric, subatmospheric or superatmospheric pressure (see page 12, line 25 through page 13, line 1), and it lacks criticality on superatmospheric pressure from the others, therefore it would have been an obvious variations to one of ordinary skill in the art.

With respect to claims 29 and 30, Lisenker discloses subjecting the device in a molecular deuterium ambient at about 500C as clearly stated in the previous Office Action.

Allowable Subject Matter

7. Claims 40-46 are allowed.
8. The following is a statement of reasons for the indication of allowable subject matter

The instant application recites a method of making a silicon nitride spacer which includes the limitations as stated below, which are neither taught nor suggested by the prior art of record:

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The instant application recites a method of making a silicon nitride spacer which includes the limitations as stated below, which are neither taught nor suggested by the prior art of record: an ammonia compound with a silane compound, wherein at least one of the compound contains deuterium to form a silicon nitride spacer containing deuterium, wherein the fabricating includes reacting a compound of the formula $\text{ND}_{(n)}\text{H}_{(3-n)}$ ($n = 1, 2, \text{ or } 3$) with a silane compound, and the silane compound is encompassed by the formula $\text{SiD}_{(m)}\text{H}_{(4-m)}$ ($m = 1, 2, 3 \text{ or } 4$), or $\text{Si}_2\text{D}_o\text{H}_p\text{X}_q$ ($o = 1, 2, 3, 4, 5, \text{ or } 6$; $p = 0, 1, 2, 3, 4, \text{ or } 5$; $q = 0, 1, 2, 3, 4, 5$; and X is halogen, with the proviso that $o + p + q = 6$).

With the presence of silicon nitride above the interface of semiconductor and insulative layer in the process of deuterium-treated semiconductor device, the undesirable diffusion of deuterium gas to the interface can be prevented while treating the semiconductor device with deuterium for improving hot carrier reliability.

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,


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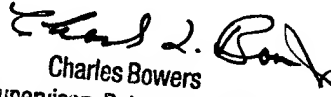
however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is (703) 305-7341. The examiner can normally be reached on Monday-Friday from 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (703) 308-4918. The fax phone number for this Group is (703) 305-3432.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.


Hsien-Ming Lee
Examiner Group 2823
September 29, 1999


Charles Bowers
Supervisory Patent Examiner
Technology Center 2800